INFLUENCE OF ABIOTIC FACTORS ON HORN FLY (*HAEMATOBIA IRRITANS IRRITANS*, L. 1758) (DIPTERA: MUSCIDAE) ABUNDANCE AND THE ROLE OF NATIVE GRASS AS A RESTING SITE IN N.W. SANTA FE PROVINCE (ARGENTINA).

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SUMMARY: The seasonal fluctuations of *Haematobia irritans irritans* (L.) and other muscoids were studied in North West Santa Fe Province, Argentina. The horn fly was found on cattle since September (spring). The population peaked in summer-early fall outnumbering the economic threshold of 200 flies per animal. Temperature was the most important abiotic factor in regulating horn fly abundance. The horn fly was collected on the grass during the afternoon and evening in late summer-early fall. This could explain the lower counts of horn flies usually found on the animals during the afternoon and evening in contrast to the morning counts. The male:female ratio was close to 1:1. The other muscoids collected had similar patterns with a peak in summer.

KEY WORDS: *Haematobia irritans*, Horn fly, Abiotic factor, Abundance, Resting sites, Argentina.

INTRODUCTION

The horn fly, *Haematobia irritans irritans* (L.) has recently been introduced into Argentina (LUZURIAGA *et alii*., 1991) and considered a factor of economic loss affecting the leather industry (TORRES *et alii*., 1993a) and the weight gain of steers (LOPEZ & ROMANO, 1993).

Horn fly populations vary during the year due to different biotic and abiotic factors. Within the latter, ambient temperature, relative humidity and precipitation are considered to be as the most important ones (KUNZ &CUNNINGHAM, 1977; PALMER *et alii*., 1981).

Because of these abiotic factors, the number of adult horn flies on cattle fluctuate during the year, maximum populations being reached during the warm and humid months. When temperature and humidity decline, adult populations fall and their generation time lengthen (KUNZ & CUNNINGHAM 1977; PALMER *et alii*. 1981).

Seasonal fluctuations have been studied in the USA (SANDERS & DOBSON, 1969; KUNZ & CUNNINGHAM, 1977; KUNZ 1980), Japan (HASEGAWA 1982, AMANO 1989), Germany (LIEBISCH, 1987), Egypt (HAFEZ & GAMAL-EDDIN, 1964 ; GAMAL-EDDIN, 1968), China (Koe, 1975) and estimated in Brazil (HONER *et alii*., 1990). However, little is known about the seasonal fluctuations of horn flies in Argentina (TORRES *et alii*., 1993b; SUAREZ *et alii*., 1995).

There are few reports concerning the distribution of *H. irritans* off the host. Casual findings were reported on the vegetation (CHAMBERLAIN, 1985) and on the floors of corrals (PAPP & GARZO, 1985).

The purpose of the present research work was to estimate the seasonal fluctuations of *H. i. irritans* on cattle as a result of the influence of several abiotic factors (temperature, relative humidity, precipitations) and in relation with other muscoid and other non-muscoid Diptera present in the study area. The role of the possible alternative resting sites of *H. i. irritans* in the area was studied.

MATERIALS AND METHODS

The study area was at San Bernardo, Departament of Nueve de Julio, Santa Fe Province, Argentina (28° 40' S, 61° 32' W). The trial took place from June 1992 to April 1993.

This area is located within the Chaquean phytogeographic province with an average annual temperature of 20-23 °C and summer rainfalls (November-March). The native area has been man-modified to an agriculture and livestock breeding area (CABRERA 1971, 1976, CABRERA & WILLINK 1980). The herbaceous stratum is composed by the gramineous *Cynodon dactylum, Paspalum dilatatum, Setaria gracili, Gouinia latifolia, Digitaria sanguinalis, Setaria argentina, Eragrostis flaccida, Gymnopogon radiatus, Panicum paucispicatum, Heteropogon contortus, Trichloris crinita.* Within the dicotyledonous *Ruellia, Justicia, Holocheilus* and *Trixis* are present. There is a variety of trees ranging from the "churqui" (*Acacia caven*), chañar (*Geoffroea decorticans*) to the large and tall "algarrobo" (*Prosopis* sp) and *Acacia* sp (CABRERA, 1971, 1976; CABRERA & WILLINK, 1980).

Paddock: An area of 25 ha with native grass and scattered trees was used as the experimental paddock. Within the same paddock, in an area of approximately 4 ha, the different sampling procedures for grass and air were carried out.

Cattle: Nineteen two-year old Brangus bulls untreated for flies and ectoparasites during the test period were used.

The number of horn flies per animal were estimated monthly to determine their monthly and seasonal fluctuations by confining the animals in a chute situated at the corner of the experimental paddock. Both sides of the animals were visually inspected and the approximate number of horn flies determined. The observations were made between 8 and 10 in the morning.

Grass: An entomological hand net BioQuip (R) with a diameter of 37cm was employed in order to collect the muscoids and other Diptera present on the grass. The sampling technique consisted of 20 sweepings on the vegetation in three different sites (total: 60 sweepings) at least 30 m away from the animals within the area of 4 ha. This was carried out at 10:00 a.m., 4:00 p.m., and 7 p.m. during two consecutive days once a month.

Other resting sites: Trees, fences, wires and gates were visually inspected for horn flies and other muscoid Diptera monthly.

Air: To capture the flying insects in the paddock, a Malaise trap (BioQuip 2875A) was installed within the experimental area during two consecutive days. The collections were made once a month at 6 a.m., noon, and 6:00 p.m.

Abiotic factors: The precipitation records for the period of study were taken from a gauge situated at the ranch. The records of ambient temperature, relative humidity for the test period as well as average, maximum and minimum precipitations for the period 1970-90 were taken from a weather station at Tostado (Santa Fe Province), about one hundred kilometers away from the ranch. In spite of the distance, the weather conditions between the two points are very similar. They are located in the same region, with the same weather, all the area is flat without any mountain range, lake or forest.

Statistics: Simple and multiple regression analyses were performed between the horn fly, muscoids and the abiotic factors studied. The hypothesis was tested (contrasted) with a level of significance of 95% (STEEL & TORRIE, 1988).

RESULTS

Temperature: Monthly maximum and minimum temperatures during the study period (July 92-May 93) are shown in Fig. 1A, D. Temperatures gradually rose from July. In April, they diminished appreciably.

Precipitations: During the period of study, precipitations may be considered as "normal" in the area. It was scarce during winter increasing in spring and summer (Fig. 1B,E). The highest precipitations were registered in December (241 mm), even higher than the highest during 1970-90 for the same month (155 mm).

Relative humidity: The relative humidity in the area is shown in Fig. 1C,F. It was never below 70%, which may be considered as usual during the period of study.

Animals: An average of only three *H. i. irritans* was found on the animals in September (spring) (Fig. 1A-C). They increased gradually to a maximum of 611 in March. In April (fall), there was a sharp decline to 116 horn flies per animal. There is a significant ($p < 0.05$) positive relationship between the number of horn flies on the animals and maximum and minimum temperature (Table 1A, B). Precipitation and humidity showed to influence horn fly populations when associated with maximum temperature (Table 1B).

The male: female ratio was about 1:1 during the months of October through April ranging from 1:0.92 in October to 1:1.3 during the months of February, March and April.

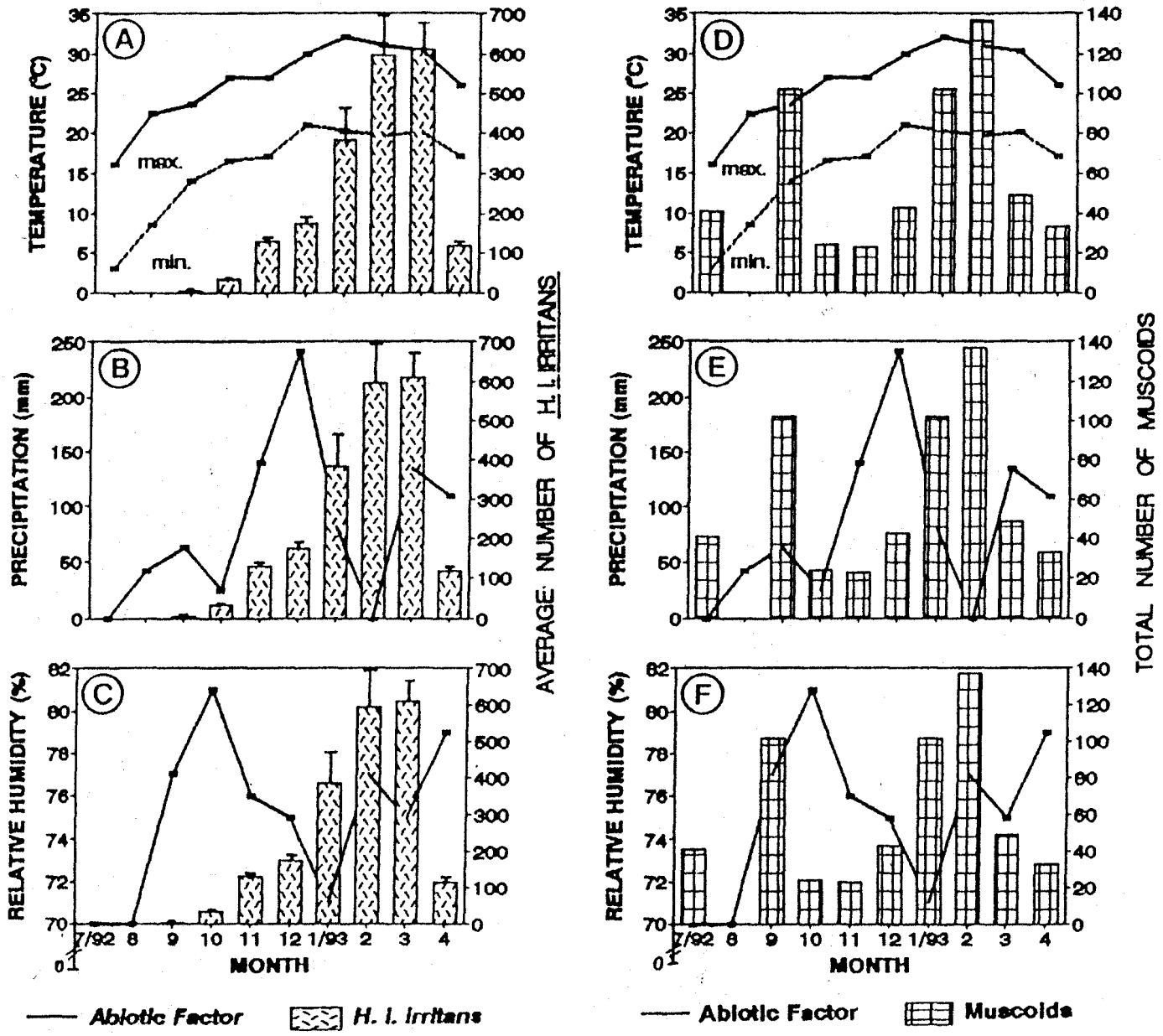

Fig. 1- Horn fly and muscoid abundance (on cattle and grass respectively) in relation to abiotic factors in N.W.Santa Fe Province (Argentina) during the months of July 1992 through April 1993. Temperature (A), precipitation (B) and relative humidity (C), and muscoid abundance on grass in relation to temperature (D), precipitation (E) and relative humidity (F).

Resting sites: *H. i. irritans* was found on the grass of the experimental paddock during March and April (late summer,early fall). In March, 2 parous females were caught for the 4:00 p.m. sampling and one parous female for the 7 p.m.sampling. In April, four females were collected at 4:00 p.m. (three parous and one nulliparous) (Fig. 2).

The other muscoid flies on the grass were more abundant during the warmer months of summer from December to March. In September, a noticeable peak was found (Fig. 1D-F and 2). Similar was the fluctuation of the other Diptera.

The ratio between *H. i. irritans* and the other muscoids was 1:2.5 and 1:2 in March and 1:5.25 in the April sampling.

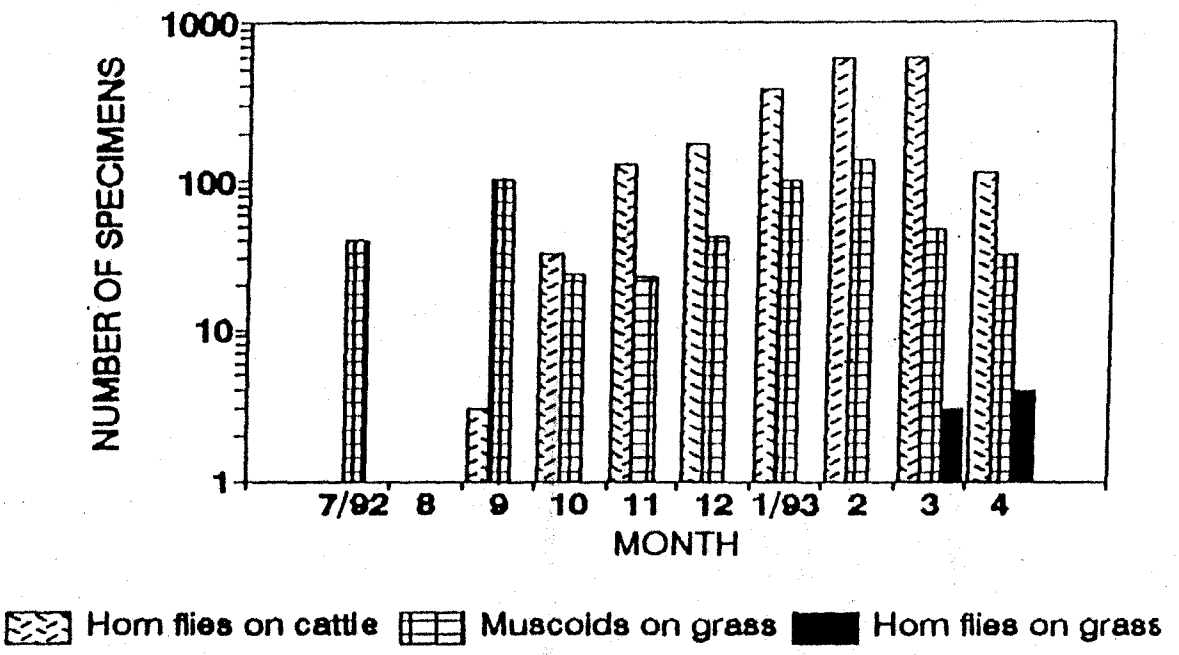

Fig. 2 - Monthly fluctuations of horn flies on cattle and other muscoids and horn flies on grass in San Bernardo (Santa Fe Province, Argentina) during the months of July 1992 through April 1993. The "Y" axes is in log scale.

Table 1 - Levels of significance (p) and R^2 coefficients (RS) resulting from the least square linear regression analysis (simple (A) and multiple (B)) of the number of *H. i. irritans* on cattle vs. the abiotic factors studied from July 1992 to April 1993 in San Bernardo, Santa Fe Province, Argentina.

VARIABLES	p=	RS
A		
Minimum temperature	0.043	0.42
Maximum temperature	0.016	0.54
Humidity	V.N.M.	0.00
Precipitation	V.N.M.	0.00
B		
Maximum temperature and Minimum temperature	0.0407	0.60
Maximum temperature and Precipitation	0.0411	0.60
Maximum temperature and Humidity	0.0444	0.59

V.N.M.: Variable not in the model

Table 2 - Levels of significance (p) and R^2 coefficients (RS) resulting from the least square linear regression analysis (simple (A) and multiple (B)) of the number of muscoids other than *H. i. irritans* caught on the grass vs. the abiotic factors studied from July 1992 to April 1993 in San Bernardo, Santa Fe Province, Argentina.

VARIABLES	p=	RS
A		
Maximum temperature	0.016	0.54
Rest of the factors	V.N.M.	0.00
B		
Minimum temperature and Precipitation	0.0411	0.60
Maximum temperature and Precipitation	0.0444	0.59

V.N.M.: Variable not in the model

At least five species of muscoid flies, in addition to several calliphorid, sarcophagid and other non-muscoid Diptera were found. At least five species of muscoid flies, in addition to several calliphorid, sarcophagid and other non-muscoid Diptera were found.

For the regression analysis of the muscoids, the first three months were not taken into account. This is because the second month was missing and the third one showed an unexplainable peak (Fig. 1D-F, 2). Considering this limitation, maximum temperature showed to influence the number of muscoid flies on the grass (Table 2A).

Precipitation was important combined with maximum temperature (Table 2B (Fig. 1E).

H. i. irritans was not found over other natural (trees, bushes) or artificial (gates, fences, wire) resting sites.
Air: H. i. irritans could not be collected by means of the Malaise trap. At least five species of other muscoids were caught as well as tabanids, sarcophagids, calliphorids and several other families of non-muscoid Diptera.

DISCUSSION

The seasonal fluctuation of *H. i. irritans* on the animals in Santa Fe Province (Argentina) was similar to that registered in other parts of the world, they were in greater numbers during the warmer and humid months (summer) and in low numbers or even disappearing in the cool months of winter. Similar results have been reported for the USA (SANDERS & DOBSON 1969; KUNZ & CUNNINGAM 1977), Russia (PETROVA, 1966), China (KOE, 1975), Japan (HASEGAWA, 1982; AMANO, 1989), Germany (LIEBISCH, 1987) and Brazil (HONER *et alii*.1990). A similar pattern of horn fly abundance has recently been reported by SUAREZ *et alii*. (1995) and also observed by the authors in La Pampa Province, Argentina.

The male: female ratio was very close to 1:1 as described by ZUMPT (1973), KUNZ & CUNNINGHAM (1977) and CICCHINO *et alii* (1994), but not 1:3 as mentioned by HILLERTON (1985). As shown by KUNZ & CUNNINGHAM (1977), females are in lower proportion during the months of summer and fall.

In the study area, temperature showed to play the most important role in determining horn fly abundance. In the case of the buffalo fly, *H. i. exigua* (De Meijere, 1913), temperature is the main factor governing rates of development in the immature stages (COOK & SPAIN, 1981). Similarly, temperature stimulates oviposition and development of *Stomoxys calcitrans* (BERRY & KUNZ 1978). PALMER *et alii*. (1981) have shown that the development of all immature stages of *H. i. irritans* are faster as temperature increases between 13 and 33 °C. KUNZ & CUNNINGAM (1977) in Texas (USA) demonstrated that the climatic factors mostly correlated to the number of horn flies were temperature, precipitation and relative humidity. In the present study, relative humidity and precipitation played a secondary role on horn fly population peak or decline on the animals. Nevertheless, a sharp fall in the number of horn flies was detected in the same study area due to flooding and pouring rains during the previous summer (TORRES *et alii*., 1992). No flooding occurred during the period of this study. The relative humidity was always above 70%, never low enough to become a limiting factor for the development of the immature stages of *H. i. irritans*.

With reference to the horn flies found on the grass of the experimental paddock, although they were caught in low numbers, the ratios horn flies on the grass: other muscoid on the grass 2.5:1, 2:1 and 5.25:1 indicate that the presence of horn flies on the grass is an important observation and should be taken into account in future studies. In La Pampa Province, Argentina, *H. i. irritans* was also found on the grass in higher numbers (46) in January (summer)(Unpublished data). They would not be migrant flies collected by chance as most migrant females are previtelogenic nulliparous (GUILLOT *et alii*., 1988) and they fly at a higher distance from ground surface (at least 1.5 meters high) (CHAMBERLAIN, 1985). In contrast, the ones found in the present study are mature and parous females, which indicates that they belong to the horn fly population under study, that is, part of the horn fly population present on the animals.

H. irritans oviposits during day and night (KUNZ *et alii*., 1970), the fact they were not found during the morning sample would indicate that the females present on the grass would not be females on their way to oviposit but part of the off-host population.

SCHREIBER & CAMPBELL (1986) observed a reduction in the number of horn flies on cattle from morning to dusk. Although this fact has been attributed to a greater distribution of the flies on the animals, which made counting more difficult, this reduction should be considered as valid, as the difference from morning to dusk was about 20%. This difference could explain the habitual presence of *H. i. irritans* on the herbaceous vegetation in the afternoon and evening during the present study.

The seasonal fluctuations of the other muscoids were similar to those of the horn fly (Fig. 2).

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SUMÁRIO

As flutuações sazonais de *H. i. irritans* (L.) e outros muscóides foram estudadas na província de Santa de Fé, no noroeste da Argentina. A mosca-do-chifre foi encontrada em bovinos a partir de setembro (primavera). O pico de população ocorreu no verão-meio outono, excedendo o limite ecônomico de 200 moscas por animal. A temperatura foi o fator abiótico mais importante no controle da prevalência da mosca-do-chifre. A mosca-do-chifre foi coletada no pasto durante a tarde e a noite no final do verão - começo do outono. Isto pode explicar as baixas contagens de mosca-do-chifre encontradas sobre os animais durante a tarde e a noite, em contraste com as contagens matinais. A proporção machos : fêmeas foi próxima de 1:1. Os outros muscóides coletados apresentaram padrões similares com um pico no verão.

PALAVRAS-CHAVE: *Haematobia irritans*, fatores abióticos para mosca-do-chifre, prevalência, locais de repouso, Argentina.

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